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IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF :  
MICHEL STREBELLE, ET AL. : EXAMINER: KEYS, ROSALYND ANN  
SERIAL NO: 10/534,299 :  
FILED: MAY 9, 2005 : GROUP ART UNIT: 1621  
FOR: PROCESS FOR THE :  
MANUFACTURE OF 1,2-EPOXY-3-  
CHLOROPROPANE

APPEAL BRIEF

COMMISSIONER FOR PATENTS  
ALEXANDRIA, VIRGINIA 22313

SIR:

This is an appeal of the Final Rejection dated July 27, 2007 of Claims 1-16. A Notice of Appeal was timely filed on December 18, 2007.

I. REAL PARTY IN INTEREST

The real party in interest in this appeal is Solvay (Societe Anonyme), having an address at 33 Rue du Prince Albert, Brussels, Belgium.

## II. RELATED APPEALS AND INTERFERENCES

Appellants, Appellants' legal representative and the assignee are aware of no appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

## III. STATUS OF THE CLAIMS

Claims 1-16 stand rejected and are herein appealed.

## IV. STATUS OF THE AMENDMENTS

An amendment under 37 CFR 1.116 was filed on October 29, 2007. This amendment was entered and considered. See the Advisory Action of November 8, 2007.

## V. SUMMARY OF THE CLAIMED SUBJECT MATTER

A summary of the claimed subject matter, as claimed in independent Claim 1, is mapped out below, with reference to page and line numbers in the specification added in **[bold]** after each element.

The subject matter of Claim 1 is drawn to a process for the manufacture of 1,2-epoxy-3-chloropropane **[page 1, lines 2-3]**, comprising reacting allyl chloride and hydrogen peroxide **[page 1, lines 20-21]** in the presence of a zeolite catalyst **[page 1, line 21, and page 3, lines 26-27]** and in the optional presence of at least one solvent **[page 1, lines 21-22, and page 3, lines 13-19]**, wherein the allyl chloride comprises less than 2000 ppm by weight of 1,5-hexadiene **[page 1, lines 22-23, and page 2, lines 1-9]**.

## VI. GROUNDS OF REJECTION

Claims 1-16 stand rejected under 35 U.S.C. §103(a) as unpatentable over US 6,288,248 (Strebel) in view of JP 04327582 (Takehisa).

## VII. ARGUMENT

Claims 1-16 stand rejected under 35 U.S.C. §103(a) as unpatentable over Strebel et al in view of Takehisa. That rejection is untenable and should not be sustained.

Claim 1 is drawn to a process for the manufacture of 1,2-epoxy-3-chloropropane<sup>1</sup> by reacting allyl chloride and hydrogen peroxide in the presence of a zeolite catalyst, where the allyl chloride comprises less than 2000 ppm by weight of 1,5-hexadiene. As shown in the Examples beginning at specification page 7, when zeolite catalysts are used in combination with reactant allyl chloride having this reduced amount of 1,5-hexadiene a dramatic and sustained improvement in catalyst life and, consequently, degree of conversion, is obtained.

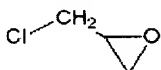
In an attempt to put forth a *prima facie* case of obviousness, the Office has combined Strebel and Takehisa.

Strebel, whose inventorship overlaps with that of the present application, discloses a process for the manufacture of epichlorohydrin by reacting allyl chloride with a peroxide compound in the presence of water, a catalyst and a diluent (column 1, line 60, to column 2, line 2). Strebel also teaches that zeolite catalysts can be used (column 2, lines 3ff) and that the peroxide compound can be hydrogen peroxide (column 2, lines 29-31).

The advance described in Strebel is the elimination of unwanted *organochlorine impurities* from the epichlorohydrin *product* (column 1, lines 25-31). This is accomplished in

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<sup>1</sup> 1,2-epoxy-3-chloropropane is also known as epichlorohydrin. It is a well known chemical intermediate having the following chemical formula:



step “(b)” of the Strebel process by application of the various extraction and purification procedures noted for the epichlorohydrin *product* beginning at col. 3, line 55 of the reference.<sup>2</sup> In addition to this difference in purpose (i.e., elimination of unwanted organochlorine impurities in Strebel as opposed to reduced 1,5-hexadiene content in the present invention) and focus on the purification of the end product, rather than the purity of a particular reactant, the Examiner admits that Strebel fails to disclose the use of an allyl chloride comprising less than 2000 ppm by weight of 1,5-hexadiene (page 4, lines 1-2 of the Final Rejection).

Takehisa describes a method for the production epichlorohydrin from allyl chloride and an alkyl hydroperoxide in the presence of a catalyst other than zeolite where the concentration of 1,5-hexadiene in the allyl chloride is reduced to 0.1 wt.% or less. See paragraphs [0007] and [0012] of Takehisa.<sup>3</sup> The purpose of Takehisa’s removal of 1,5-hexadiene from the allyl chloride is described in paragraphs [0004] and [0005]: because olefinic compounds have similar properties to the product epichlorohydrin, it is better to remove them from the starting materials rather than wait and try to remove them and their byproducts from the product epichlorohydrin.

The Office has concluded that one skilled in the art would have been motivated to use the purified allyl chloride of Takehisa in the process of Strebel to prepare epichlorohydrin without formation of the unwanted by-product, 1,2-epoxy-5-hexene (page 4, lines 10-15 of

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<sup>2</sup> See the paragraph bridging cols. 1-2 for a description of the two steps (a) and (b), making up the Strebel process where step (a) relates to the chemical reaction and step (b) relates to the separation of the epichlorohydrin product.

<sup>3</sup> Applicant filed an English version of Takehisa (JP 04327582) on April 24, 2007. The catalyst in Takehisa is described in, e.g., paragraph [0012] at page 6 of the English version. Suggested for use are the acetylacetonate, alcoholate, naphthonate, etc. of metals such as molybdenum, tungsten, etc. Zeolites are not suggested. The oxidizing agent in Takehisa, alkyl hydroperoxide, is described in paragraph [0010] of the English version, where cumene hydroperoxide, ethylbenzene hydroperoxide, etc. are suggested. Hydrogen peroxide, as used in the present invention, and Strebel, is not suggested.

the Final Rejection). Additionally, “[t]he Examiner believes that the teaching of Takehisa is properly combinable with the teaching of Strebelle because they are directed to analogous subject matter, i.e., epoxidation of an allyl chloride with a peroxide, and both seek to solve a similar problem in the art, i.e., generation of unwanted by-products which are difficult to remove from epichlorohydrin” (page 4, lines 16-19 of the final Rejection).

With respect to the combinability of the references, Stebelle describes a reaction using allyl chloride, hydrogen peroxide and a zeolite catalyst, while Takehisa uses allyl chloride, an alkyl hydroperoxide and a catalyst other than zeolite. Thus, in a three component reaction - reactant, oxidizing agent and catalyst - Strebelle and Takehisa differ significantly in their choice of *two of the three*. These are not analogous reactions. While the product of the two reactions is the same, the mechanisms of the reactions are necessarily different in view of their use of different oxidizing agents and different catalysts. In addition, while Strebelle and Takehisa both desire a pure product, their approach is quite different: Strebelle subjects the product to enhanced purification, while Takehisa purifies a reactant before reaction.

This noncombinability of Strebelle and Takehisa is further evident in view of the 1998 article by Sheldon, originally submitted to the Examiner on October 29, 2008,<sup>4</sup> wherein Takehisa’s catalysts are described as ineffective with Strebelle’s peroxide:

“One property which soluble Ti(IV) compounds and Ti(IV)/SiO<sub>2</sub> share is marked sensitivity toward deactivation by strongly coordinating ligands, especially water. For this reason Ti(IV)/SiO<sub>2</sub> is an ineffective catalyst for epoxidations with aqueous hydrogen peroxide.” (footnote omitted, emphasis added)

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<sup>4</sup> A copy of Sheldon is attached hereto in the Evidence Appendix.

See Sheldon at page 485, third paragraph, lines 1-5. Thus, in Sheldon the catalyst used by Takehisa in , e.g., Example 1 thereof (see paragraph [0015] of the translation) is described as *noneffective* when combined with Strebelles's aqueous hydrogen peroxide. Clearly, one of ordinary skill in the art would not have combined these references in view of this teaching, and certainly would not have had an expectation of success in so doing.

The Examiner has simply "mixed and matched" the necessary elements of Strebelles and Takehisa in order to arrive at the present invention in a hindsight manner, using a "one from column A, one from column B" approach, ignoring the fact that Strebelles specifically pairs hydrogen peroxide with a zeolite catalyst while Takehisa pairs an alkyl hydroperoxide with different catalysts, and ignoring the fact that the combination of Strebelles's peroxide with Takehisa's catalyst was specifically taught *against* by the art. There is no motivation to purify allyl chloride when using a zeolite catalyst, or hydrogen peroxide, as in Strebelles and the present invention, nor is there motivation to combine Strebelles's peroxide with Takehisa's catalyst.

Thus, in view of the above discussion it is clear that Strebelles and Takehisa are quite different from one another in both purpose and execution. As such, the references are not combinable, and even when combined do not teach the process as claimed. As no *prima facie* case is presented by the combination of references, the rejection should be reversed.

To any extent that a *prima facie* case is found to exist, which is not the case, there would be absolutely no expectation of an improvement in zeolite catalyst life upon a combination of the teachings of Strebelles and Takehisa. At best, the only possible improvement that could be anticipated would be the provision of a more pure product.

In the present case the unexpected improvement in catalyst life as provided by the present invention has been amply demonstrated in the present specification. As shown in the Examples beginning at page 7, when zeolite catalysts are used and the allyl chloride is free of

1,5-hexadiene according to the present claims (a combination nowhere provided in any single reference applied) a dramatic and sustained improvement in catalyst life and, consequently, degree of conversion, is obtained. For example, and as shown in Table 1 at specification page 7, production using normal allyl chloride is exhausted at 27 hours, while allyl chloride according to the present invention remains active at 147 hours of reaction time. Similar results are shown in Tables 2 and 3, all of which show an impressive extension of catalyst life and conversion percent.

At the top of page 6 of the Final Official Action the position is taken that Applicants' demonstrated improvement in catalyst life is "inherent." Applicants point out that MPEP 2112, Part IV, second paragraph, states: "[i]n relying upon the theory of inherency, the Examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art", citing *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990) (emphasis in original). However, the totality of the theory of inherency put forth in the Final Official Action is that "the Examiner believes that the prior art references when combined would give one an easy method for obtaining high purity epichlorohydrin product that would inherently overcome the reduced catalyst life problem" (Final Rejection, page 6, first paragraph). This theory is not only incorrect, it also lacks the requisite basis in fact and/or technical reasoning. Accordingly, the Examiner has not met her burden for a rejection based on inherency.

Furthermore, it is legal error for the Office to conclude that the unexpected results flowing from Applicants' invention are inherent in the Examiner's prior art construct (i.e., the combination of Takehisa and Strebel). The question to be asked is whether the results are unexpected in view of the closest prior art, and in this case the answer is yes. Instead, the Examiner has compared the results of the claimed invention with the results of the theoretical

combination of the references relied upon in the §103 rejection which, in the Examiner's opinion, is the claimed invention. Requiring comparison of the results of the invention with the results of the invention is prohibited. See MPEP 716.02(e) and *In re Chapman*, 357 F.2d 418, 148 USPQ 711 (CCPA 1966). Therefore, Applicants' invention is patentable in view of the demonstration of superior results because neither Takehisa nor Strebel, nor their combination, disclose or suggest such an advantage.

Accordingly, it is respectfully requested that this rejection be REVERSED.

#### VIII. CONCLUSION

For the above reasons, it is respectfully requested that the rejection be REVERSED.

Respectfully submitted,

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CLAIMS APPENDIX

1. A process for the manufacture of 1,2-epoxy-3-chloropropane, comprising reacting allyl chloride and hydrogen peroxide in the presence of a zeolite catalyst and in the optional presence of at least one solvent, wherein the allyl chloride comprises less than 2000 ppm by weight of 1,5-hexadiene.

2. The process according to Claim 1, wherein the allyl chloride comprises less than 1000 ppm by weight of 1,5-hexadiene.

3. The process according to Claim 2, wherein the allyl chloride comprises less than 200 ppm by weight of 1,5-hexadiene.

4. The process according to claim 1, wherein the reaction is carried out at a temperature from 45 to 80°C.

5. The process according to claim 1, wherein the reaction is carried out at a pH maintained at a value from 3 to 4.5.

6. The process according to claim 1, wherein the amounts of allyl chloride and hydrogen peroxide are such that their molar ratio is from 2 to 7.

7. The process according to claim 1, comprising reacting allyl chloride and hydrogen peroxide in the presence of a zeolite catalyst and in the presence of at least one solvent, wherein the solvent comprises methanol.

8. The process according to claim 1, wherein the zeolite catalyst comprises TS-1.
9. The process according to claim 1, wherein the catalyst is present in the form of a fluid bed.
10. The process according to claim 1, wherein the reaction is carried out in a loop reactor comprising recirculation of the reaction medium.
11. The process according to claim 1, comprising reacting allyl chloride and hydrogen peroxide in the presence of a zeolite catalyst and not in the presence of at least one solvent.
12. The process according to claim 1, comprising reacting allyl chloride and hydrogen peroxide in the presence of a zeolite catalyst and in the presence of at least one solvent.
13. The process according to claim 12, wherein said at least one solvent comprises at least one C<sub>1</sub>-C<sub>5</sub> alcohol.
14. The process according to claim 1, wherein the zeolite catalyst comprises ZSM-5.
15. The process according to claim 1, wherein the zeolite catalyst comprises ZSM-11.
16. The process according to claim 1, wherein the zeolite catalyst comprises MCM-41.

EVIDENCE APPENDIX

1. Roger A Sheldon et al., "Heterogeneous Catalysts for Liquid-Phase Oxidations: Philosopher's Stones or Trojan Horses?" *Acc. Chem. Res.* 1998 *31*, 485-493.(Copy Attached)

RELATED PROCEEDINGS APPENDIX

None.